

CLAIMS

1 - A spacer for keeping a space between two substrates formed from glass sheets, more particularly
5 a space of small thickness, generally less than a few millimeters, over the entire area of the sheet substrates, in a device such as a display screen, vacuum-type insulating glazing or a flat lamp, the surface of said spacer being at least partly
10 electronically conducting, characterized in that said spacer is formed from a core not exhibiting electronic conductivity, the shape and the constituent material of which are chosen to provide the thermomechanical integrity of the substrates in the final device, said
15 core being at least partly coated with at least one layer of a glass exhibiting electronic conductivity, and capable of giving the spacer electronic conductivity at 50°C of 10^{-13} to $10 \text{ ohm}^{-1} \cdot \text{cm}^{-1}$.

2 - The spacer as claimed in claim 1,
20 characterized in that it has electronic conductivity of 10^{-12} to $10^{-2} \text{ ohm}^{-1} \cdot \text{cm}^{-1}$.

3 - The spacer as claimed in either of claims 1 and 2, characterized in that the glass constituting a coating layer comprises at least 1 mol%, preferably at
25 least 5 mol%, of at least one oxide of a transition element of Groups IB, IIIB, VB, VIB, VIIIB and VIII of the Periodic Table of the Elements that may exist in a number of oxidation states.

4 - The spacer as claimed in claim 3,
30 characterized in that the transition element(s) are selected from V, Cr, Mn, Fe, Co, Ni, Cu, Nb, Mo, Ru, Rh, Ta, W, Re, Os, Ir, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Tm and Yb.

5 - The spacer as claimed in one of claims 1
35 to 4, characterized in that the glass constituting a coating layer is a glass having the following composition, in mol%, for a total of 100 mol%:

	(A) SiO ₂	25-75
	(B) at least one oxide of a transition element as defined in either of claims 3 and 5 4 ... 1-30	
	(C) Al ₂ O ₃	0-40
10	(D) ZrO ₂	0-10
	(E) at least one from Li ₂ O, Na ₂ O and K ₂ O ...	0-10
	(F) at least one from MgO, CaO, SrO and BaO	0-40
15	(H) B ₂ O ₃	0-30
	(I) P ₂ O ₅	0-5
20	(J) TiO ₂	0-10
	(K) ZnO	0-10
	(M) the usual additives.....	0-1
25	(N) the usual impurities.....	complement to 100 mol%

6 - The spacer as claimed in one of claims 1 to 5, characterized in that the coating is a coating 30 consisting of one layer.

7 - The spacer as claimed in one of claims 1 to 6, characterized in that a layer of the coating glass has a thickness from 1 to 10 000 nm, preferably from 1 to 2000 nm.

35 8 - The spacer as claimed in one of claims 1 to 7, characterized in that at least one layer of at least one agent for promoting the adhesion and/or bonding of the coating to the core has been placed between the core and the coating.

40 9 - The spacer as claimed in one of claims 1 to 8, characterized in that the core is made of a material selected from glasses, such as soda-lime glasses, aluminosilicate-type glasses and borosilicate type glasses; from ceramics and from polymers, said 45 core advantageously being formed from the same glass as

that forming the substrates with which the spacer is intended to be used.

10 - The spacer as claimed in claim 9, characterized in that the core is a glass having an expansion coefficient between 20 and 300°C of between 60×10^{-7} and $105 \times 10^{-7} \text{ K}^{-1}$, preferably between 60×10^{-7} and $95 \times 10^{-7} \text{ K}^{-1}$, in particular between 75×10^{-7} and $95 \times 10^{-7} \text{ K}^{-1}$, it being possible for a glass of the borosilicate type to have an expansion coefficient of 10 between 30×10^{-7} and $50 \times 10^{-7} \text{ K}^{-1}$.

11 - The spacer as claimed in one of claims 1 to 10, characterized in that the core is a glass having a temperature corresponding to the strain point of greater than 500°C.

15 12 - The spacer as claimed in one of claims 1 to 11, characterized in that the core is a glass having an elastic modulus greater than 90 GPa, preferably greater than 100 GPa, in particular greater than 130 GPa.

20 13 - The spacer as claimed in one of claims 1 to 12, characterized in that the core is a glass having the following composition, in mol% for a total of 100 mol%:

25	(A') SiO ₂	.....	25-75
	(C') Al ₂ O ₃	.....	0-40
	(D') ZrO ₂	.....	0-10
30	(E') at least one from Li ₂ O, Na ₂ O and K ₂ O	...	0-10
	(F') at least one from MgO, CaO, SrO and BaO	.....	0-40
35	(G') at least one oxide of at least one from Y, La and elements of the lanthanide series	.....	0-25
	(H') B ₂ O ₃	.....	0-30
40	(I') P ₂ O ₅	.....	0-5

	(J') TiO ₂	0-10
	(K') ZnO	0-10
5	(L') nitrogen in combined form	0-20
	(M') the usual additives	0-1
10	(N') the usual impurities	complement to 100 mol%.

14 - The spacer as claimed in one of claims 1 to 13, characterized in that the core of the spacer has a prismatic shape, especially a pillar, elongate beam, 15 cylindrical or spherical shape.

15 - The spacer as claimed in one of claims 1 to 14, characterized in that it has an electrical resistance to the flow of current of between 10⁻⁵ and 10⁷ GΩ.

20 16 - The spacer as claimed in one of claims 1 to 15, characterized in that it has a density of greater than 3.

25 17 - The spacer as claimed in one of claims 1 to 16, characterized in that it is black or dark in color.

18 - The spacer as claimed in one of claims 1 to 17, of the type of those having the shape of pillars or of elongate beams, characterized in that metal electrodes have been deposited on the sections of the 30 pillars or the edges of the elongate beams in order to facilitate the removal of surface charges from the spacer to the electrodes placed on the substrates.

19 - A process for manufacturing a spacer as defined in one of claims 1 to 18, characterized in that 35 at least one coating glass layer is deposited on at least one part of at least one element selected from a core already manufactured or an element obtained at one stage in the manufacture of the latter, the glass used for the deposition having a composition selected so 40 that, if this composition is modified during

deposition, in the finished product it is the composition as defined in one of claims 1 to 7.

20 - The manufacturing process as claimed in claim 19, characterized in that the core is
5 manufactured by the following successive operations:

- drawing of a preform bar of polygonal cross section, advantageously polished on all its lateral faces;

- cutting of the drawn bar into several rods;

10 - assembly of these rods so as to be parallel to one another in such a way that they are properly held;

- cutting to the desired length in order to form spacers;

- optionally, polishing of the ends of the spacers
15 all together; and

- disassembling the spacers from one another, the operations of depositing the coating layer or layers being carried out on the preform bar before it is drawn and/or on the rod before it is cut to the
20 desired length and/or on the ends of the assembled spacers and/or on the individual spacers.

21 - The process as claimed in either of claims 19 and 20, characterized in that the coating layer(s) are formed by evaporation, said process
25 comprising the steps consisting:

- in depositing at least one element to be coated, placed on a support, in a vacuum chamber and in placing a refractory container, containing the glass to be deposited, in said vacuum chamber; and

30 - in heating the refractory container to a temperature between 500 and 2000°C, while maintaining the element(s) to be coated at a lower temperature in order to create conditions under which the glass sublimes and forms a coating layer on the surface of
35 the element(s) to be coated.

22 - The process as claimed in either of claims 19 and 20, characterized in that the coating layer(s) are formed by sputtering, said process comprising the steps consisting:

5 - in placing a target in a chamber containing a gas at low pressure, said target being formed from the glass to be deposited and facing at least one element to be coated;

10 - in causing the gas contained in the chamber to ionize; and

 - in controlling the electrical potential of the target in such a way that gas particles bombard the target, detaching material therefrom, which material is then deposited on the element(s) to be coated.

15 23 - The process as claimed in one of claims 19 to 22, characterized in that before a coating glass layer is deposited, at least one layer of an agent improving the adhesion or bonding of the coating is deposited on the elements to be coated.

20 24 - The process as claimed in one of claims 20 to 22, characterized in that a heat treatment in an oxidizing or reducing atmosphere is applied to the coated element formed by the rod before it is cut to the desired length or formed by the final core for the 25 purpose of adjusting the electronic conductivity and/or the secondary emission coefficient and/or the dielectric properties and/or the bonding of the coating.

 25 - A spacer obtained by the process as 30 defined in one of claims 19 to 24.

 26 - The use of a spacer as defined in one of claims 1 to 18 or manufactured by the process as defined in one of claims 19 to 24 as a spacer for display screens, vacuum glazing and flat lamps 35 comprising at least two glass sheets.

27 - A display screen, especially of the plasma or field emission type, in particular of the field emission type, vacuum glazing and flat lamp comprising at least two glass sheets separated by
5 spacers as defined in one of claims 1 to 18 or manufactured by the process as defined in one of claims 19 to 24.